SHEAR
Chartered Structural Engineers

STRUCTURAL INVESTIGATION REPORT AT HALL FARM BARN, WORSTON, BB7 1QA.

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Survey Date:	19th March 2024 1pm. Weather overcast but dry.
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INTRODUCTION

Shear Limited was instructed by the building owner Mr. Matthew Leyden on the 18th March 2024 to carry out a structural investigation to detached barn at Hall Foot, Worston, BB7 1QA with a view to its conversion for residential purposes.

This report specifically addresses any significant structural short comings (apparent during the visit) and items of disrepair which we would consider likely to affect the building's suitability in regards to its proposed redevelopment.

The report is written by Richard Lomax MIStructe BEng (Hons).

The report should not be construed as a valuation report and is not an inventory of every single defect, some of which would not significantly affect the use of the structure. If the report does refer to some minor defects; this does not imply that the structure is free from other such defects.

The report does not appraise the condition of dpc, possible damp penetration, condensation or the condition of the timber components with regard to rot and infestation from a visual perspective. These issues may be highlighted as potential problems but specialist advice needs to be sought on these non-structural matters.

No building services (gas, electricity, water, heating), manholes and drainage systems, garages and other outbuildings, the boundary structures, retaining walls, paths and drives, windows, doors and other joinery items, internal and external décor / plaster / ceiling finishes, rainwater goods, kitchens and bathrooms will be inspected unless noted otherwise in the report.

No other part of the structure will be exposed that is covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect.

The investigation was carried out internally from within the buildings and at ground level externally. Further defects may be encountered upon following more extensive investigation, involving exposure of structural elements for example that may be recommended in the report.

The report does not include any calculation assessment to ascertain the structural capacity/ adequacy of the structure. The Author knows of no reason why the structural calculations should not be of a standard designed in accordance with British Standards and subject to Local Authority approval at the time of its design and construction.

The Author has no knowledge of the structure's construction or condition prior to the investigation only that noted in the clients brief and a selection of photographs.

This report is intended for use only by the building owner Mr. Matthew Leyden in relation to its renovation. No other third party may use this report without the written consent of Shear Ltd.

STRUCTURE DESCRIPTION

The structure is basically a detached traditional farm building built circa early 1900 set on a gently sloping site to the rear of Hall Foot, refer photograph P1 below.

P1

The structure is constructed of coarsed/ random solid stone/ granite wall construction with earth floor, which steps down at various levels following the sloping site. Random positioned openings dominate the front elevation. A single storey annex is attached to the rear, which follows the slope of the roof.

Internally, there is one buttressing cross wall to the left hand side of the main barn arch entrance.

Former first floor joists (removed) span left to right off primary timber beams spanning front to back with central timber posts.

The roof is traditional timber purlin and rafter construction off oak kingpost trusses (3 number equally spaced) supporting stone slate coverings. The roof is hipped at both gables formed off the end trusses. Hips members off traditional dragon ties.

Overall stability of the structure appears to be provided by the external solid wall construction/ buttressing wall and diaphragm floor construction (now removed).

FRONT ELEVATION INSPECTION FINDINGS

Inspection of the front elevation revealed part of the right hand elevation has been removed and temporarily propped above, refer photograph P2 below. This was carried out as the lower wall section had bulged out considerably according to operative on site.

P2

Stone arch lintel (in two pieces) dropped one side requiring timber prop as shown in photograph P2 above.

Wall construction is 18” thick overall with a 9-10” thick coarsed outer stone leaf. Random stone to inner leaf with a hard lime mortar between bed joints. Lime mortar well weathered.

Inspection from the side revealed the elevation undulates across with minor outward bulging at first floor level.

Inspection of the left hand side revealed vertical cracking over ground floor window and below circular window opening, refer photograph P3 below. Stone cill cracked.

Vertical cracking below circular window extends up from what appears to be a former opening that has not been toothed across correctly.

P3

LEFT HAND GABLE INSPECTION/ FINDINGS

Inspection of the left hand end gable revealed no significant cracking indicative of structural movement, refer photograph P4 below.

P4

When inspected from the front elevation the gable was relatively plumb and aligned given the age of the building but with some minor outward movement towards the rear eaves.

Stone track level higher than the internal floor levels to side.

RIGH HAND GABLE INSPECTION/ FINDINGS

Inspection of the right hand end gable revealed no significant cracking indicative of structural movement, refer photograph P5 below.

P5

When inspected from the front elevation the gable was relatively plumb and aligned given the age of the building but with some minor outward movement towards the rear eaves, similar to the left hand gable.

BARN INTERNAL INSPECTION FINDINGS

Inspection internally revealed the left hand side of the arch has dropped nominally with resulting diagonally cracking extending past the first floor primary beam up to the truss bearing, refer photograph P6 below. This is less pronounced externally.

P6

First floor primary beam poorly located closely to arch centre – refer photograph P6 above.

Very little masonry to side of arch due to large elongated opening – little masonry to resist lateral force imposed by the arch.

The only internal buttressing wall to front elevation is impaired by the door opening position directly adjacent elevation. This should be moved internally to allow a masonry pier to buttress elevation.

Kingspan roof trusses appeared in relatively good condition when inspected from ground floor level, refer photograph P7 below.

P7

Timber purlins appeared in relatively good condition free of significant cracking/ fissures but slight mid-span laterally bowing to the downside.

Rafter replacement evident to area adjacent rear slope/ ridge – refer photograph P7 above.

Poor positioning of first floor windows in relation to the truss bearings, refer photographs P8 and P9 on the following page.

P8

P9

Relatively large vertical cracking evident to left hand gable, refer photograph P10 below. Not prominent to external elevation.

P10

First floor joists removed from structure. Primary beams and posts still in place.

Ground floor levels vary and consist of earth and ground bearing concrete.

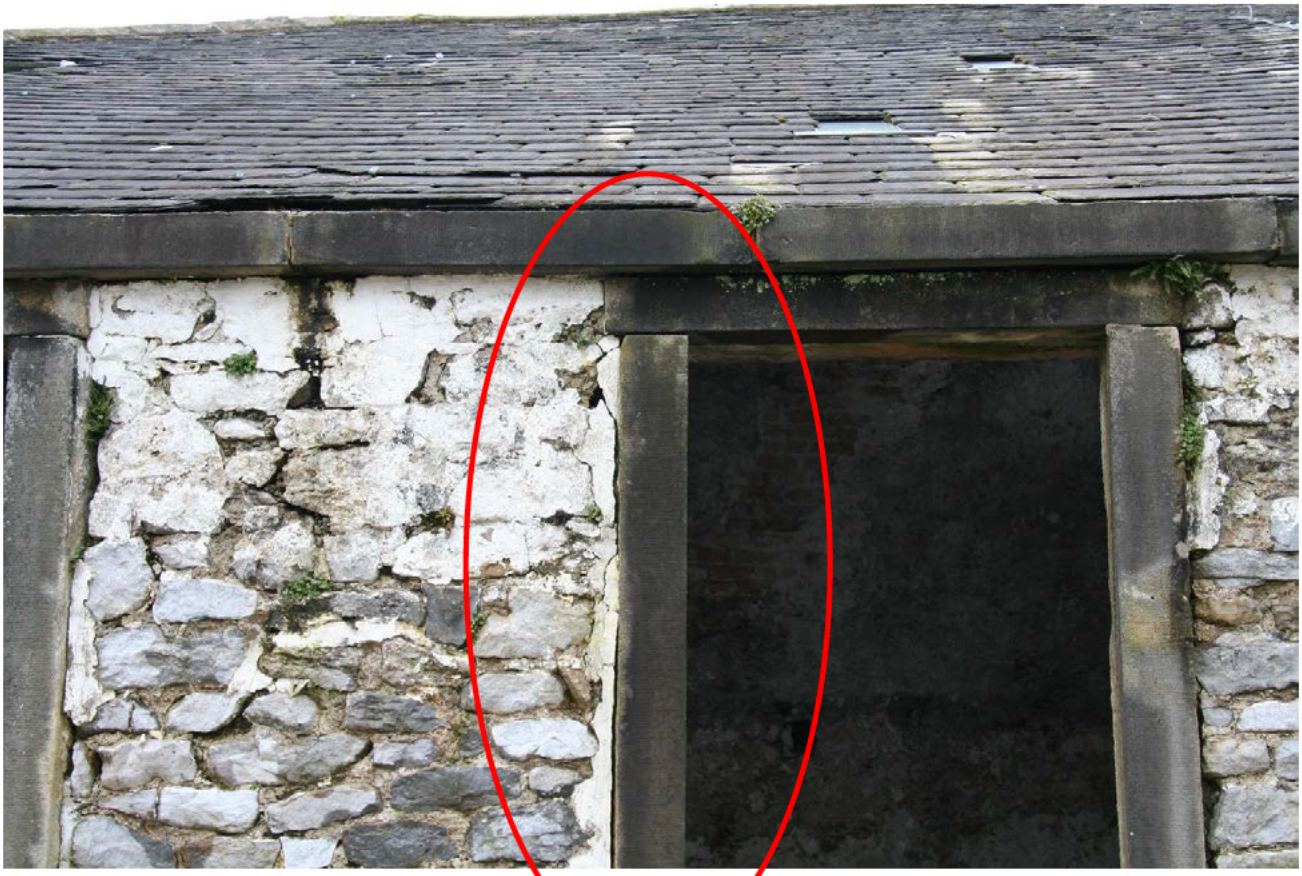
REAR ANNEX INSPECTION FINDINGS

Rear annex of similar construction with timber purlin construction, refer photograph P11 below.

P11

Elevation generally plumb and aligned and free of significant cracking indicative of structural movement.

Stone jamb movement evident to window opening, refer photograph P12 below.



P12

Inspection of the annex side elevation revealed no significant cracking indicative of structural movement, refer photograph P13 below.

P13

Stone lintel to door opening snapped, refer photograph P13 above and P14 below.

P14

Relatively large vertical diagonal cracking evident to main barn rear elevation wall, refer photograph P15 below. Not prominent within main barn.

P15

3 painted timber purlins appeared in relatively good condition free of significant cracking/ fissures but slight mid-span laterally bowing to the downside.

BARN CONCLUSION/ RECOMMENDATIONS

The vertical cracking to the barn walls is most likely associated with footings constructed off variable soil stratum, which is typical of old farm buildings. Farm buildings are often founded off large stone units dug down to firm relatively shallow depths following the general slope of the land, whose stiffness can vary along the length of wall. With reference to soil maps, the subsoil to the area is predominantly Glacial Till. Trial holes should be dug to determine the footing depth, thickness, construction and subsoil properties for suitability, which will also aid the Architect in determining the ground floor construction.

The vertical cracking evident has been further exasperated by the poor selection of stone units to the inner leaf (lack of longer sections) unlike the better bonded outer leaf, where the cracking is not mirrored. The extent and effectiveness of the two leaf's tying is unknown without further intrusive works but is unlikely to be of modern standards. Modern wall tying could be introduced following further intrusive investigations. Over time the mortar has not be maintained contributing to the wall's weakness.

Inherent design weaknesses in the structure have led to the lateral movement of the walls outwards. Timber roof construction, especially supporting heavy stone slates will have sagged over time causing the rafters to push out at eaves level, a phenomenon known as eaves spread. The lack of a substantial floor structure tied to the walls at mid height level has allowed the wall to move outwards albeit at a very slow pace.

Ground floor openings to the front elevation have been poorly positioned at strategic load-bearing points below truss and first floor primary beam bearings contributing to the walls weakness and how it performs when it settles under variable soil stratum. Ideally, proposed openings shall be positioned away from load-bearings points or suitable lintels incorporated.

The lack of masonry to the side of the main arch needs consideration such as a depth of masonry over the ground floor opening being introduced. The arch may need to be reset as well given its settlement on one side.

Given the buildings age in the Authors opinion the majority of the settlement has taken place but further subtle movement over time cannot be discounted due to changes in soil moisture content through the seasons especially were founded off clay (Glacial Till). This is likely to be relatively small given the volume change potential of clay in the North West of England is generally low.

It is imperative the walls are strengthened especially at positions of weakness highlighted by the cracking. The Author would recommend modern crack stitching techniques using stainless steel helical bars and minor wall repair, replacing small stone units with longer units by competent stone mason – both techniques to span across cracks to provide a stronger and better bond. Tying of the two leaves should be further investigated and mortar raked and repointed throughout.

Any new floor structure (and roof) should be effectively tied to the wall structure in accordance with modern Building Regulations.

Appoint timber specialist to inspect at high level and intrusively investigate the timber truss/ purlin/ rafter/ lintel elements and check for rot infestation – locally repair/ strengthen, were applicable.

Make good to the external fabric to prevent water penetrating the external fabric by re-pointing sympathetically and replace missing stone units ensuring all rain and surface water is directed to drainage systems and away from the building and footings.

Replace internal window/ door timber lintels with more modern robust materials such as steelwork or precast concrete. Replace cracked stone lintels.

The building would structurally benefit from the introduction of ground floor buttressing walls (ideally at 1/3 points either side of the main arch entrance) toothed into the front and rear elevations with internal door opening positioned away from the elevations. New walls would need to be constructed off new footings.

Overall, in the Authors opinion, there are no structural reasons to preclude satisfactory refurbishment of the building without major reconstruction (i.e. demolition/ rebuilding) leading to the enhancement of the building for its proposed residential purpose.